# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

The growing demand on highways over that past couple of decades, has led to a dramatic increase in need to rehabilitate our existing pavements. This rehabilitation technique is not new in USA and European countries, but even though is much more needed due to economical circumstances; it will take quite a while to implement in Asian countries. The implementation of recycling is very limited in Asian countries especially in Malaysia which could be due to lack of experience and limited guidelines. Broadly, there are two basic categories of pavement recycling or rehabilitation based on method used: Hot Recycling and Cold Recycling. These methods are further categorized as based on carrying in-situ (in place) or isolated arrangements made to recycle and recycled material being transported to the site. Cold in place recycling (CIPR) has advantages over mere cold recycling as saving time, labour and funds. The process includes pulverization of pavement, addition of some water (OMC as determined in laboratory), laying with a recycler equipment (usually a truck or lorry), compaction and curing to achieve hydration process. An overlay of desired design requirements is placed on top of this reclaimed surface.

Since during the pulverization process the bond between coated particles of asphalt is broken hence a loss of friction is occurred. To regain the stability and friction a stabilizer is introduced. The engineering properties of the new recycled pavement some times called Reclaimed Asphalt Pavement (RAP) and stabilizer are of utmost importance. These properties provide basis for future rehabilitation techniques and standards adoption; include strength of recycled material, amount of stabilizer used, relationship between RAP and stabilizer. This study focuses to evaluate the use of ordinary Portland cement (OPC) as a stabilizer as observed in a CIPR project.

## 1.2 Problem Definition

There exists a need to revise the rehabilitation standards and specifications, material properties and strength requirements. Much recent asphalt research focuses on lessening risks of early pavement failures through performance type specifications. Until now there have been no performance-related specifications for CIPR and many agencies have never used such recycling techniques because of lack of confidence in CIPR performance. This was the basis to create base for this thesis.

## 1.3 Objectives of the study

The objectives of the research are as follows:

i. to evaluate the properties of cold in place recycling material obtained from study site.

ii. to determine the appropriate amount of cement in terms of strength and cost effectiveness.

iii. to predict the life of new recycled pavement using software WESLEA 3.0

## 1.4 Scope of Study

Pulverized RAP material is collected from a study site near Malacca. Variation in strength is determined by varying the amount of cement i.e. 2%, 4% and 6% and curing time of 7 days and 28 days. Resilient modulus is obtained from 7 day compressive strength test. Prediction of pavement life is based on Software WESLEA 3.0. It is in terms of applications of standard single axles with 18000 pound load.

## 1.5 Background studies

RAP can be used as granular base or sub-base material in all pavement types. For low traffic volume roads, RAP may be stabilized using various cheaper materials including fly ash or rubberized self cementing materials. High volume traffic applications require the use of superior material for stability of pulverized material obtained at site. One good option is OPC. Although it provides a high quality bond between pulverized particles, it's relatively costlier than fly ash and other stabilizer materials. Results obtained though are more significant than fly ash and other materials.

CIPR involves reuse of the existing pavement material without the application of heat. Except for any recycling agent, no transportation of materials is usually required, and aggregate can be added, therefore hauling cost is very low. Normally an asphalt percentage by weight of RAP, fly ash or cement or even quicklime may also be added. These additives are effective for over asphalted and low stability mixes. The process includes pulverizing the existing pavement, sizing of the RAP, application of recycling agent, placement, crushing and mixing units, is quite common. The dept of treatment typically varies from 75 mm to 100 mm (3 to 4 in).

CIPR is a cost-effective treatment for deteriorated pavements and a recent FHWA policy statement recommends recycled materials to be considered for all pavements projects in USA. A survey of 38 department of Transportation indicated that many routinely use the technique, but there are some problems with performance reliability, specially pointing to a lack of uniform, defined design procedure and problems with raveling, thermal cracking, early strength and curing time. This is the basic reason that many agencies and department are reluctant to use this technology.

Therefore there exists a need to revise the rehabilitation standards and specifications, material properties and strength requirements. Much recent asphalt research focuses on lessening risks of early pavement failures through performance type specifications. Until now there have been no performance-related specifications for CIPR and many agencies have never used such recycling techniques because of lack of confidence in CIPR performance.

## 1.6 Overview of the methodology

The overall methodology used for the experimentation to achieve the above mentioned objectives is shown in Figure 1.1. It includes obtaining the material from a study site and evaluating its properties in laboratory. The results obtained from laboratory are planned to analyzed and used with software WESLEA 3.0 to predict pavement life in terms of rutting and fatigue failures.

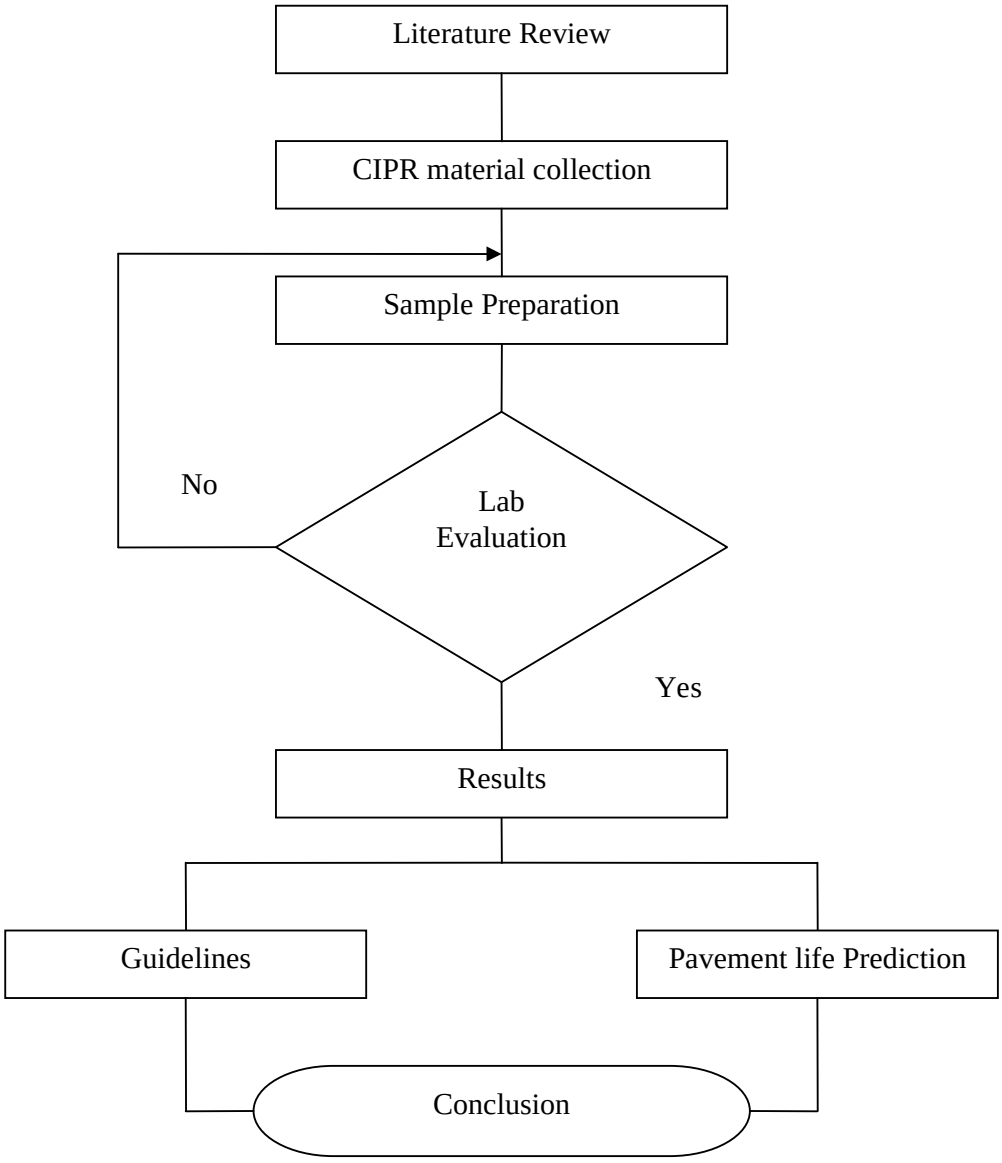


Figure 1.1: Schematic diagram summarizing the experimental approach